NUTRITIONAL ASSESSMENT OF LOCALLY PRODUCED ZOBO AND SOYMILK DRINKS IN ADO-EKITI METROPOLIS, NIGERIA

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Abstract

This study investigated the physicochemical properties and microbial quality of locally produced selected zobo and soymilk in the different streets of Ado Ekiti, Ekiti State, Nigeria. Samples were analysed for pH, total solids, turbidity, alkalinity, titratable acidity, total dissolved solid, total suspended solid, total bacteria count and some heavy metals. pH ranged from 3.62 – 4.80 for zobo while 6.33 - 7.35 for soymilk, the titratable acidity ranged from 0.02 - 0.07mg/l, turbidity (370-1780 NTU), total solids (11.60 - 31.70 mg/l), total dissolved solid (10.30 - 28.50 mg/l) and total alkalinity was between 16.70 - 60.50 (mg/l). Mineral composition analysed shows that Lead ranged between 0.002 - 0.012 ppm; chromium ranged between 0.007 - 0.066 ppm; while cobalt ranged between 0.002 - 0.020 ppm. Results of microbial analysis indicated that there was no gas producing organism in the samples hence the drinks were safe for consumption due to the low level of the detected total viable count compare with World Health Organization standard.

Keywords: Physicochemical, heavy-metals, mineral, microbial, consumption

1.0 Introduction

A beverage or drinks as it is popularly called in the country are simply a drinkable liquid that are not water. There are basically two types of beverages: alcoholic and Non-alcoholic beverages (Abdelazim and Abdelazim, 2018).

Alcoholic beverages are drinks that contain at least 0.5 – 75% alcohol. They are produced by the introduction of yeast for fermentation into substances such as Grapes, Grains, Barley, Fruits, Sugarcane, Rice and Calyx. Examples of alcoholic beverages are Wine, Champagne, Beer, Whiskey, Brandy, liquor, etc. Non-Alcoholic beverages are drinks that do not contain any form of intoxicating substance; they are mostly sweet carbonated drinks and stimulants. They are also known as soft drinks which comes in different variations such as mineral water, juices, squashes, syrups, smoothies, shakes, and local drinks such as zobo, kunun-zaki, soymilk (Abdelazim and Abdelazim, 2018).

Roselle plant *(Hibiscus sabdariffa)* locally known as asam kumbang, asam susur, and asam paya is belonging to the large family of *Malvaceae* (Osman *et al*., 2011). It is also commonly known as Roselle (English). Zobo is a locally made Nigerian beverage that is made from dried hibiscus plant flowers also known as Roselle. It is very popular among the Nigerian populace because of its ever-refreshing nature as it is always served chilled. Zobo is made by boiling the hibiscus plant flower at 100^0C in water for 20 min together with other ingredients such as ginger, garlic, pineapple which help to improve the taste. (Adegoke *et al.,* 2008)

Soyabean (*Glycine max*) is a high-protein legume grown as food for both humans and livestock. Soymilk, also called soya milk or soy milk is a plant-based drink produced by soaking and grinding soybeans, boiling the mixture, and filtering out the remaining particles (Odu and Egbo, 2012). Soymilk is affordable and economical when compared to industrial processed cow milk. This increasing popularity as a beverage worldwide is credited to its health benefits which include low cholesterol and lactose, its ability to reduce bone loss and menopausal symptoms, prevention and reduction of heart diseases and certain cancers (Kolapo and Jimoh, 2007). The milk is a white or creamy emulsion which almost look like cow milk (conventional milk) in both appearance and consistency (Iwe, 2003). The objectives of this research work are to ascertain the hygienic standards of some locally produced drinks such as zobo and soymilk, which are sold in Oke Ureje,

Emirin, Oja Bisi, Idemo, and Odo Ado in Ado-Ekiti by evaluating their microbiological, nutritional quality and the effect of spices on the sensory parameters of the zobo drink under different storage conditions.

2.0 Materials and Method

2.1 Source of Material

Zobo drink and Soymilk drink used for this research work were bought from different location in Ado local government, Ado Ekiti, Ekiti State.

Table 1: Zobo samples collected at different locations

Sample code	Place of collection
A (Zobo)	Oke ureje
B (Zobo)	Emirin
C (Zobo)	Oja bisi
D (Soymilk)	Idemo
E (Soymilk)	Emirin
F(Soymilk)	Odo Ado

2.2 Methods of Analysis

All the samples were taken to the laboratory immediately after sample collection and all the analysed parameters were concluded within 72 hours post sample collection. The physiochemical parameters in this study were determined according AOAC, (2005).

2.2.1 pH value using pH meter, total solids, total dissolved solid (mg/L), total suspended solid (mg/L), titratable acidity and turbidity (NTU) were all determined according to AOAC (2005).

2.2.2 Total alkalinity was determined according to Zacharias et al. (2002).

2.3 Bacteriological analysis of the samples was carried out using the pour plate method with nutrient agar according to Adegoke, (2000).

3.0 Result and discussion

Table 2: Physicochemical Properties of selected Zobo and Soymilk Drinks in Ado Ekiti metropolis

Sample	pH	Titratable Acidity (mg/L)	Alkalinity (mg/L)	Total Solid (mg/L)	Total Dissolved Solid (mg/L)	Total Suspended Solid (mg/L)	Turbidity (NTU)
A	$4.80^{e}\pm0.05$	$0.06^{b}\pm0.00$	$40.30^{b}\pm0.10$	$11.95^{e}\pm0.05$	$10.60^{e}\pm0.05$	$1.34^{d}\pm0.00$	$370.0^{e}\pm0.00$
B	$3.62^{f}\pm0.01$	$0.07^{a}\pm0.01$	$60.50^{a}\pm0.50$	$15.65^{d}\pm0.04$	$13.82^{d}\pm0.03$	$1.82^{d}\pm0.00$	$407.0^{d}\pm0.00$
C	$5.23^{d}\pm0.01$	$0.05^{b}\pm0.00$	$37.50^{c}\pm0.20$	$11.60^{e}\pm0.20$	$10.30^{f}\pm0.04$	$1.18^{e}\pm0.01$	$370.0^{e}\pm0.00$
D	$6.85^{ab}\pm0.12$	$0.03^{c}\pm0.01$	$23.50^{e}\pm0.10$	$21.90^{c}\pm0.03$	$19.60^{c}\pm0.09$	$2.25^{c}\pm0.01$	$940.0^{c}\pm0.00$
E	$7.35^{a}\pm0.01$	$0.02^{d}\pm0.00$	$16.70^{f}\pm0.10$	$27.90^{b}\pm0.02$	$25.35^{b}\pm0.03$	$2.54^{b}\pm0.01$	$1050.0^{b}\pm0.01$
F	$6.33^{b}\pm0.07$	$0.05^{b}\pm0.01$	$30.30^{d}\pm0.20$	$31.70^{a}\pm0.07$	$28.50^{a}\pm0.10$	$3.18^{a}\pm0.01$	$1780.0^{a}\pm0.00$

Data was presented as mean ± standard deviation (S.D) for triplicate determinations. Mean within the same column with the same superscripts were not significantly ($p \leq 0.05$) different.

3.1 Table 2 presents the physicochemical parameters of zobo and soymilk. The results showed turbidity of the zobo samples ranged between 370 to 407 NTU while soymilk ranged from 940 to 1780 NTU. Value obtained from soymilk is higher than that of zobo samples. This indicates that soymilk had more particles than zobo. This could also be as a result of the processing methods and location of production. Turbidity is the cloudiness of water caused by a variety of particles. pH is the measure of the acidity and alkalinity of a sample. The pH of all the zobo samples ranged from 3.62-5.23 while soymilk samples ranged from 6.33-7.35. The value obtained were not in accordance with WHO standard of potable water (WHO, 2011) of pH of 7 which is considered adequate for drinking water. This could be as a result of water used for the production. The maximum recommended Total Suspended Solid (TSS) limit set by WHO, (2011) is 25mg/L, the TSS ranged from 0.51-0.82 mg/L which are not in accordance with the WHO standard which maybe as a result of materials used for the production.

Total Dissolved Solid (TDS) are inorganic matters and small amounts of organic matter, which are present in as solution in the samples. TDS of zobo ranged from 10.30-13.82 mg/L while that, of soymilk ranged from 19.60 to 28.50mg/L. Soymilk had the higher Total Dissolved Solid (TDS) compare to zobo samples. The variation in the value obtained in the samples could be as a result of sieving methods or aids used during processing. Total Suspended Solid (TSS) are the inorganic matters or particles present in the samples, the value ranged from 1.18 to 1.82mg/L for zobo while soymilk ranged from 2.25 to 3.18mg/L. Soymilk from Odo Ado was observed to have the highest TSS while the TSS obtained from all the experimental zobo samples were relatively similar.

Total Solid (TS) are inorganic matter present in the samples. The value in zobo samples ranged from 11.60 to 15.65mg/l while in soymilk, its ranged from 21.90 to 31.70mg/L. Soymilk obtained from Odo Ado had the highest value (31.70 mg/L), followed by soymilk from Emirin (27.90 mg/L) and zobo obtained from Oja Bisi had the least value (11.60 mg/L). Soymilk had the higher Total Solid (TS) compare to other samples.

The titratable acidity value of the zobo ranged from 0.05 to 0.07 mg/L while soymilk ranged from 0.02 to 0.05.mg/L. Zobo obtained from Emirin had the highest titratable value (0.07mg/L) which was lower compared to the acceptable requirement as reported by NIS, (1997) followed by zobo obtained from Oke ureje. Generally, the value obtained in zobo was higher than that of soymilk drinks. Similarly, the same sample pattern was observed in alkalinity of the samples. Zobo obtained from Emirin had the highest value of alkalinity (60.50mg/L) while soymilk obtained from Emirin had the least alkalinity value (16.70mg/L).

Table 3: Mineral Composition of Selected Zobo and Soymilk Drinks in Ado Ekiti Metropolis (ppm)

Samples	Lead	Cadmium	Chromium	Cobalt	Nickel	Arsenic
A	0.002±0.001	ND	0.030±0.003	0.005±0.001	ND	ND
B	0.005±0.002	ND	0.050±0.02	0.012±0.001	0.003±0.001	0.004±0.001
C	0.012±0.001	0.001±0.000	0.066±0.002	0.020±0.001	0.008±0.002	ND
D	0.003±0.000	ND	0.016±0.004	0.012±0.001	0.002±0.000	ND
E	ND	ND	0.010±0.002	0.002±0.000	ND	ND
F	ND	ND	0.007±0.001	ND	ND	ND

Data was presented as mean ± standard deviation (S.D) for triplicate determinations

Table 3 shows the mineral composition of zobo and soymilk samples from the street in Ado Ekiti town. Lead, chromium, cadmium, nickel, arsenic and cobalt were assessed and detected in the samples. The results show that chromium value ranged between 0.007 and 0.066 ppm. It is known to be one of the toxic essential heavy metals, it is highly detrimental to humans when its concentration exceeds tolerable limits by humans. It aids in the biosynthesis of glucose tolerance factor (Iwegbue *et al*., 2013), utilization of sugar protein and fats (Oriskawe and Ajaezi, 2014), catabolism of fat and carbohydrates, and the maintenance of blood glucose, especially in diabetic patients (Salako *et al*., 2016). The value ranged from 0.007 to 0.066 ppm. Zobo obtained from Oja-bisi had the highest chromium value, followed by zobo obtained from Emirin (0.050 ppm) while soymilk obtained from Emirin had the least value (0.010 ppm). The value obtained in selected zobo and soymilk from different location was lower than what was recommended by WHO, (2011) of 0.05 mg/l.

Nickel was not detected in sample B, C and D while the value of Nickel detected in sample A, E and F ranged from 0.002 to 0.008 ppm. Zobo obtained from Oja bisi had the highest value (0.008 ppm). The value was lower compare to that of WHO (0.07mg/l) recommendation. Nickel is one of the trace heavy metals found in the environment. It has been reported in potable water sources in Nigeria (Izah *et al*., 2016).
Cadmium is one of the toxic heavy metal to human tissues even at low concentration (Walter and Silliker, 2016). Cadmium was not detected in all the sample except sample F (soymilk from Odo Ado) which showed the minimal value of 0.001 ppm which was still lower (≤ 0.003 mg/L) compare to world health organization Standard for guideline for good water quality (WHO, 2011) Hence, the samples were prepared in a healthy environment and fit for consumption but sample F (soymilk from odo ado) was an exception.

Arsenic is one of the non-essential heavy metals found in the environment. Its concentration in ingestible items suggests contamination (Izah *et al.,* 2016) All samples showed absence of arsenic compound except sample E which showed the minimal value of 0.004 ppm and this suggest that sample E is not fit for consumption due to the presence of arsenic. Cobalt of the selected zobo samples ranged from 0.002 to 0.013 ppm while selected soymilk ranged from 0.005 to 0.020 ppm. For selected soymilk, sample F showed the absence of cobalt compound. Sample C (zobo from Oja bisi) had the highest value (0.020 ppm) while sample E (soymilk from Emirin) had the least value (0.002 ppm). For selected zobo, sample B and C showed the absence of Lead content while sample A showed 0.003 ppm of Lead content. The value of lead content ranged from 0.002 to 0.012 ppm. Sample F (soymilk from odo ado) had the highest Lead content. Lead is known to cause toxicity and poisoning in individuals exposed to them. Lead poisoning can lead to various disease symptoms, including anemia, convulsion, central-nervous system disorders (Garba *et al*., 2015).

Table 4: Total Bacteria Count of selected Zobo and Soymilk (cfu)

Sample	24hours $\times 10^3$	48hours$\times 10^3$
A	ND	11.00
B	2.00	27.00
C	3.00	5.00
D	18.00	22.00
E	35.00	37.00
F	-	12.00

ND = Not Detected

3.3 Discussion on Total Bacteria Count of selected Zobo and Soymilk Drinks in Ado Ekiti metropolis

Table 4 above shows the total viable count of bacteria in selected zobo and soymilk product. At 24 hr the number of colonies developed for zobo was within 2.0×10^3 cfu/ml to 3.0×10^3 cfu/ml while no colony was detected in sample A. Sample C (zobo from Oja Bisi) had the highest total viable count while sample B (zobo from Emirin) had the least count (2.0×10^3 cfu/ml) and at 48 hr, the number of colonies was 5.0×10^3 Cfu/ml to 27.0×10^3 cfu./ml. Sample B (Zobo from Emirin) had the highest total viable count while zobo from Oja bisi had the least count (5.0×10^3 Cfu/ml). The total viable count of soymilk at 24 hours was 18.0×10^3 Cfu/ml to 35.0 $\times10^3$ which were higher (10 Cfu/ml) compare to the requirement standard (NIS, 1997) while no colony was detected in sample F. Sample E had the highest value while sample D had the least value (18.0×10^3 Cfu/ml). At 48 hr, the total viable count developed was 12.0×10^3 Cfu/ml to 37.0×10^3 Cfu/ml. Soymilk from Emirin had the highest total viable count while sample F had the least count (12.0×10^3 Cfu/ml).

4.0 Conclusion

From the results obtained from the present study, it can be concluded that most of the parameters analysed on the selected zobo and soymilk samples from the street of Ado Ekiti State were within the minimum acceptable limits for non-alcoholic drinks as stipulated by Nigeria Industrial Standard, (1997). However, the amount of heavy metals detected were at minimal value. Moreso, from microbial analysis, selected zobo and soymilk from Emirin had the highest total viable count of bacteria than all the samples. I hereby recommend that Good Hygienic Practices (GHP) in terms of good quality materials, good environment and hygienic handling during and after production should be highly considered to make the drinks free of contamination and fit for consumption.

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